Home Canning and Public Health*

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THE art of food preservation by canning in the factory has never been on a sounder basis than it is today. Hundreds of thousands of dollars have been spent to bring the industry to its present position. Spoilage has been greatly reduced and no outbreaks of botulism have been attributed to factory-canned foods packed in America since 1925. This statement becomes still more significant when the relatively small amounts of home-canned foods in contrast to the large amounts of factory-canned foods are considered. The situation for home-canned foods, however, is not so fortunate. Procedures are still recommended to the homemaker which not only give products which may not keep well but which may poison her entire family. Frequent warnings have been given of the danger of inadequate processes. Schoenholz, Esty, and Meyer [1] warned that home-canned foods may be dangerous when they said:

> The prevention of human botulism will, therefore, remain a difficult problem until safe processing procedures are employed in the household for the preservation of certain vegetables.

This opinion has been borne out by large yearly tolls of botulism caused by home-canned foods since then. Fellers [2] made the following statement:

> The canning guides, bulletins, circulars, and recipes distributed by state agencies, magazines, women's clubs, and manufacturers of canning equipment contain many erroneous statements and faulty methods which have been directly responsible for several outbreaks of botulism besides causing great losses through spoilage of good human food. Accurate and safe directions for preserving food products should be prepared by state colleges and similar agencies in order that any present faulty, unsafe methods may be rectified.

A similar warning was issued by the California State Department of Health in 1933.[3] Despite these emphatic statements, little attention seems to have been given to the problem by some of those who are advising home-makers, and botulism outbreaks caused by improperly processed home-canned foods continue.

Any method of food preservation may be evaluated largely from two positions —spoilage and food poisoning. The former has been almost entirely ignored by some of those who disseminate information to the home-canner. Little actual information is available, however, on spoilage, for the average homemaker keeps no records. Neither is she trained to detect all kinds of spoilage, and undoubtedly many home-canned foods which have started to spoil, are prepared for the table because evidences of spoilage are not sufficiently pronounced. Although this phase of the problem need not be stressed unduly before this Association, spoilage is closely related to poisoning. A preserved food in which considerable spoilage has taken place may be potentially dangerous. *Clostridium botulinum,* the agent of poisoning of greatest

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interest in this connection, may produce profound changes in the foodstuff. Foods which have undergone such changes would ordinarily be excluded from the diet. However, it is definitely known that toxin may be present without evidences of decomposition.

Few studies seem to have been made on the keeping qualities of foods preserved by methods used by the home-maker. Stienbarger [4] summarized the results of such studies started by the Bureau of Home Economics in 1917. The period elapsing between processing and opening varied from 2 months to 5 years and averaged 1 year. In general, jars which were stored for longer times showed greatest spoilage. Containers which had imperfect closures were excluded from the summary. Bacteriological examinations were, in general, not made. Cursory examination for the usual signs of spoilage (condition of the container, appearance, odor, and sometimes flavor) was the only criterion. Bacteriological examination would probably have shown higher incidence of understerilization. Of 3,434 jars and cans of food, most of which were processed in boiling water, 1,659, or 48 per cent, showed evidences of spoilage. Of 783 jars processed in the steam pressure cooker, 93, or 12 per cent, spoiled. Stienbarger, however, pointed out that since some of these jars had been packed, longer processing times have been found to be desirable and 12 per cent spoilage is probably much larger than would be found today. The foods most frequently spoiled were meats, fish, corn, lima beans, and peas. Meats and fish processed in the water-bath showed heavy spoilage.

The report should be read by all who are directly interested in home-canning and especially by those who still favor boiling water processes for non-acid foods. To show a few of the data reported by Stienbarger, Table I has been prepared. Spoilage, it will be seen, is as high as 71 per cent in one food. In some cases the process times used were shorter than those recommended today, in others they were longer. Comparison of process times used with the foods in Stienbarger's report with those now recommended by some manufacturers of canning equipment indicates that they compare quite well. Sunderlin, Nelson, and Levine [5] also reported the results of comprehensive studies in home-canning. Their work was carried out "with a view to securing spoilage data and time tables for this method of canning vegetables and meats. . . . Process times found entirely satisfactory, under the conditions of the experiments were 2½ hours for beans and chard, 3 hours for beef and pork, and 20 minutes for tomatoes."

Bacteriological tests on the jars consisted of microscopic examination of the sediment, plate count at 37 and 20° C., and growth in fermentation tubes. No attention was given to anaerobic spore-forming, or thermophilic bacteria, the organisms chiefly responsible for spoilage in canned foods. Furthermore, the majority of the jars were not incubated at 37° or 55° C. before examination. In a pack of green beans the temperatures of storage had a decided effect on the keeping qualities. No difference was observed between basement and room temperatures since no spoilage occurred after 2½ and 2 hr. boiling water processes. However, at 37° C., and 55° C., the amount of spoilage was 66 and 100 per cent respectively. They interpreted this to indicate that sterility was not obtained although products were secured which would keep if stored at sufficiently low temperatures. What would the "keeping quality" have been if all of the jars had been stored at 37° and 55° C.? They reached the conclusion that whether better results would be obtained by the use of the pressure cooker than by the boiling

water bath remained to be seen. Adequate methods of examination of the jars might have given a different picture. The possible relation of food poisoning by *Cl. botulinum* to home-canned foods was not studied. They refused, however, to taste of their foods even though the processes were said to have been satisfactory under the conditions of their experiments.

Spoilage might be considered to be of economic importance mainly and botulism of public health significance. *Cl. botulinum,* however, is a spoilage organism and any pack of non-acid home-canned foods in which there is an undue amount of spoilage may be considered to be potentially dangerous because it probably has been understerilized.

TABLE I

SHOWING SPOILAGE RECORD OF HOME-CANNED FOODS PROCESSED IN BOILING WATER

(After Stienbarger, 1933)

	1919			*1920*		
Vegetable	*Number*	*Spoiled*	*% Spoiled*	*Number*	*Spoiled*	*% Spoiled*
Asparagus				127	17	13
Corn	49	35	71	73	66	90
Lima Beans	106	15	14	83	21	25
Peas	62	9	15	61	42	69
Spinach	153	66	43	63	34	54
String Beans	133	52	39	156	79	51

As stated above, not an outbreak of botulism has been caused by foods canned in American factories since 1925. This fortunate situation results from the expenditure of large sums of money to learn more about *Cl. botulinum,* heat penetration into canned foods, and other factors important in canning. The situation for canning in the home is not so satisfactory. Each year sees its toll of human lives which, to a great extent, may be credited to some extension services, editors of cookbooks, and manufacturers of supplies for the home canner. In Table II, the recommendations of a number of such authorities are given. How long such a situation will be allowed to continue remains to be seen. In some states serious outbreaks of poisoning had to occur before any real advance could be made in changing unsound recommendations. The outbreaks of botulism which have occurred in the United States for the years 1929 to 1933 inclusive are shown in Table III.* Examination of Table III should convince one that something is wrong with procedures used by home-canners, for home-canned foods are involved in practically every outbreak during these years. Stronger evidence that home-canning literature needs revision need not be sought. In the *31st Biennial Report* of the Department of Public Health of California it was stated that since 1889, 192 known cases of botulism occurred, 119 of which resulted fatally. Most of them were said to have been caused by home-canned foods. If graduates of schools of home economics and others who consider themselves capable of recommending procedures for the home-maker do not recognize all bacteriological knowledge, they should be forced to do so by those whose duty it is to conserve the public health. It would be unfortunate to have to resort to legal procedures to indicate that those who distribute unsound literature have some responsi-

* This list is not complete; other outbreaks attributed to home-canned foods were reported.

TABLE II

SHOWING RECOMMENDATIONS TO HOME-CANNERS BY VARIOUS AUTHORITIES

Authority	*Date*	*Vegetables*			*Meats*		
		Oven	*Boiling Water*	*Pressure Cooker*	*Oven*	*Boiling Water*	*Pressure Cooker*
Automatic Canning Devices, Inc.	1931			R			R
Peoples Gas Light and Coke Co., Chicago	1933			R			R
Dixie Canner Co., Hot Springs	2nd ed.			R			R
Sears, Roebuck & Co., Chicago	*			R			R
Montgomery Ward & Co., Chicago	*			R			R
Ladies Home Journal, Philadelphia	JE 1072			R			R
The Washington Bureau				R			R
Good Housekeeping	1931			R			R
The Detroit Free Press				R			R
Burpee Can Sealer Co.	1934			R			R
The Delineator				R			
The National School of Pressure Cooking	1934			R			R
The Coleman Lamp and Stove Co., Wichita	A 225			R			R
Ball Bros. Co., Muncie, Indiana	1933	R	R	R	R	R	R
Owens-Illinois Glass Co.			R				
Kerr Glass Mfg. Corp., Sand Springs, Okla.	1934	R	R	R	R	R	R
International Harvester Co.	1927		R	R		R	R
Boston Woven Hose and Rubber Co.	1933	R	R	R		R	R
The Chicago Tribune		R			R		
The Chicago Herald and Examiner		R	R	R			
The Chicago American		R	R	R			
The Detroit Free Press				R			R
Boston Sunday Advertiser	1933	R	R	R	R	R	
The Detroit News	1932	R	R	R	R	R	R
The Philadelphia Public Ledger			R	R			
The American Stove Co.	1930	R			R		
Boston Cooking School Cook Book (Farmer)	1931	R	R	R			
Foods and Home Making (Greer)	1931			R			
Every-Day Foods (Harris and Lacey)	1927		R	R			R
The Settlement Cook-Book (Kander)	1931		R				
Successful Canning and Preserving (Malcolm)	1930		R	R			R
The Butterick Cook-Book (Rose)	1924		R	R		R	R
The Blue Gingham Cook-Book (Wolcott)	1928		R				
The Pictorial Review Cook-Book	1931	R	R	R		R	R

TABLE III

BOTULISM OUTBREAKS FOR THE YEARS 1929–1933

Location	*Product*	*Method of Preparation*	*Cases*	*Deaths*	*Remarks*
Chicago	Shallots	Imported	2	1	Packed in Italy
California	Persimmons				
Yakima	String Beans	Home Canned	2		
The Dalles	Beets	Home Canned	2	1	
Green Bay	Celery	Home Canned	2	2	
Hudson, Wyo.	Beans	Home Canned	6	4	
Salida, Colo.	Sausage and Tomatoes?		4	2	Newspaper Report
California	Pork Loin	Home Pickled	3	2	
		1930 OUTBREAKS			
Trinidad, Colo.	Chili con Carne	Home Canned	3	2	
Sidney, Nebr.	Asparagus	Home Canned	4	2	
Sentinel Butte, N. D.	String Beans	Home Canned	4	4	
Torrance, Calif.	Tuna	Home Canned	5	3	Type B
		1931 OUTBREAKS			
Scotts Bluff, Nebr.	Spinach	Home Canned	2	2	Type B proven
Purrell, Colo.	String Beans	Home Canned	3	2	
Amarillo, Tex.	Spinach	Home Canned	2	2	
Los Angeles, Calif.	Antipasto	Imported	3	1	Packed in Italy
Bishop, Calif.	String Beans	Home Canned		1	Type A
Saugerties, N. Y.	Spinach or Chard	Home Canned	5	2(?)	
Grafton, N. D.	Vegetable Salad	Home Canned	16	13	Type A
Newport, Ore.	Salmon (Smoked)	Home Canned	2	2	
Pueblo, Colo.	Corn	Home Canned	42 Chickens		

(*Table III Cont. p. 306*)

bility to the public. Furthermore, those who interpret scientific data for those who are less informed, must leave nothing unsaid. Improperly processed home-canned foods are hazardous.

Canned food technologists are agreed that non-acid foods must be processed only under steam-pressure. Steam-pressure cookers have been devised for this purpose, but the mere use of such a cooker is not sufficient, for it must be correctly used and the non-technical home-maker must be taught to appreciate the necessity of following instructions which come with the cooker. Some of these instruction books should be more carefully written.

Practically all pressure cookers depend on a pressure gauge alone for controlling temperature. This is probably satisfactory if the gauge is of high quality and all air is removed from the cooker. The pressure gauges furnished with some cookers are probably untrustworthy. However, good canning practice should provide for a reliable thermometer with which the actual temperature may be determined. This is necessary not only because the atmosphere in the cooker may contain considerable air, but because the gauges may become faulty by use year after year without inspection and adjustment. The effect on temperature of various amounts of air in the steam is well shown in Figure I. Stienbarger's

TABLE III
(Continued)

BOTULISM OUTBREAKS FOR THE YEARS 1929–1933

1932 OUTBREAKS

Location	*Product*	*Method of Preparation*	*Cases*	*Deaths*	*Remarks*
Pueblo, Colo.	Peppers	Home Canned	2	2	
Biola Fresne, Calif.	Corn	Home Canned	1	1	
Bordeaux, Wash.	Corn	Home Canned	1	1	
Phillipsburg, Pa.	String Beans	Home Canned	2	2	
Verdel, Nebr.	Corn	Home Canned	3	3	
Burger, Tex.	Beet Tops	Home Canned	2	2	
Gordon, Mont.	Pork	Home Canned	4	2	
Glenwood Spr., Colo.	Cauliflower	Home Canned	1	1	
Cleveland, Ohio	String Beans	Home Canned	0	0	
Maryville, Tenn.	Vegetable Soup Mixture	Home Canned	7	6	
Modale, Ia.	Corn	Home Canned	24	23	Chickens
Sams Valley, Ore.	Carrots	Home Canned	Horse and Chickens		

1933 OUTBREAKS

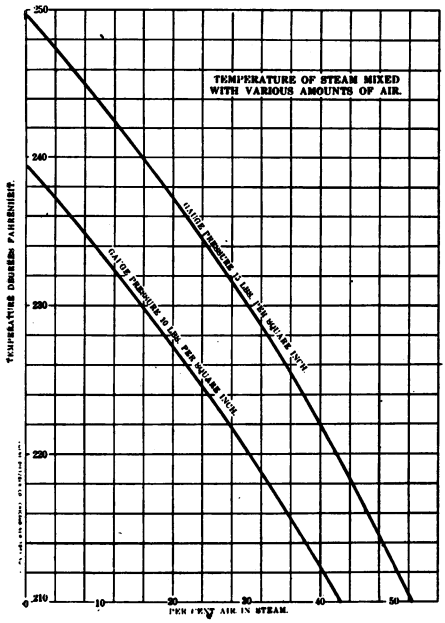
Coeur d'Alene, Ida. (?)	Beans	Home Canned	4	2	
Miles City, Mont.	String Beans	Home Canned	3	2	
Corona, Calif.	Beets	Home Canned	2	1	
Morro Bay, Calif.	Beets	Home Canned	2	2	
Dayton, Wash.	Beets	Home Canned	5	3	
Lakeside, Ohio	Beets (?)	Home Canned	3	2	
Missoula, Mont.	Beet tops	Home Canned	3	3	
Santa Margarita, Calif.	Green Peppers	Home Canned	2	2	
Zurich, Ont.	Tomatoes (?)	Home Canned	3	1	
Alamosa, Calif.	Corn	Home Canned	84		Chickens and Turkeys
Joseph, Ore.	Spinach	Home Canned	83		Chickens

summary [4] showed 12 per cent spoilage in vegetables and meats processed in the steam-pressure cooker. This would seem to indicate that more attention should be given by home economics extension advisers to recommendations for operating such cookers. The mere use of such cooker may not yield sound foods. One of the outbreaks of fowl botulism reported in 1933 resulted from home-canned food processed in a steam-pressure cooker.

Some of the advice given the home-maker on the operation of the pressure cooker is quite interesting if not sound scientifically. For instance, the *Ball Blue Book* advises allowing a tiny stream of steam (known as "bleeding" in factory canning) to escape during processing.* The reason given is as follows: "This is done to prevent

* "Bleeding" is a technical term applied to the act of allowing a small jet of steam to escape from the retort or cooker during processing. In this manner, air pockets and the like are avoided and the operator is more certain that all air is driven out.

FIGURE I



suction which results in drawing liquid from jar." *The Ball Blue Book* recommends a pressure of 10 lb. in the cooker with a processing time of 40 minutes for most vegetables, 60 and 90 minutes for a few others, and 120 for sweet potatoes. This would give a temperature of 240° F. These recommended processing times and temperatures are too low for such foods, processed even under steam pressure under conditions which obtain in the steam-pressure cooker. The *Kerr Home Canning Book* is still more ambiguous. It recommends steam pressure of from 10 to 15 lb. (240° F. to 251° F.) leaving the home-canner to choose which she shall use. The advice "All vegetables and meats canned at home should be boiled 10 or 15 minutes before tasting," is sound and necessary and would seem to indicate that they do not have entire confidence in their recommendations. The cooks which are recommended by both of the books just mentioned are shorter than those recommended by the U. S. Department of Agriculture. The fact that the glass container has a marked retarding effect on the rate of rise of temperature is also important and is not given the significance due it.

Two other methods of processing have been advised since the early days of home-canning—the boiling water-bath and the oven. The boiling water-bath was advised in the earliest bulletins distributed by the U. S. Department of Agriculture. *Farmers' Bulletin 359* advised a 5 hour process in boiling water for vegetables. *Farmers' Bulletin 839* stressed the fact that any food could be canned in the home by methods recommended in that bulletin. Three methods of canning were advised—hot-water-bath at 212° F., water-seal process at 214° F., and the steam-pressure cooker. *Farmers' Bulletins 853* and *1211* retained the methods of former bulletins. *Farmers' Bulletin 1471*,[7] appearing in 1926, showed the effects of consideration of the results of bacteriological researches. The time-tables for processing foods were arranged for acid and non-acid foods. Experience with botulism had indicated that non-acid foods (vegetables and uncured meats) must receive special treatment. *Bulletin 1471*, therefore, went the entire distance and recommended no other method than heating under steam pressure for vegetables and meats.* The controversies which led to this position were reviewed in a former paper.[6] Even though this bulletin, revised in May, 1932, stated emphatically that hot-water-bath processing was not recommended for vegetables, the great majority of extension services and bulletins published by equipment manufacturers carried time-tables for processing in the hot-water-bath and oven. They have not accepted the

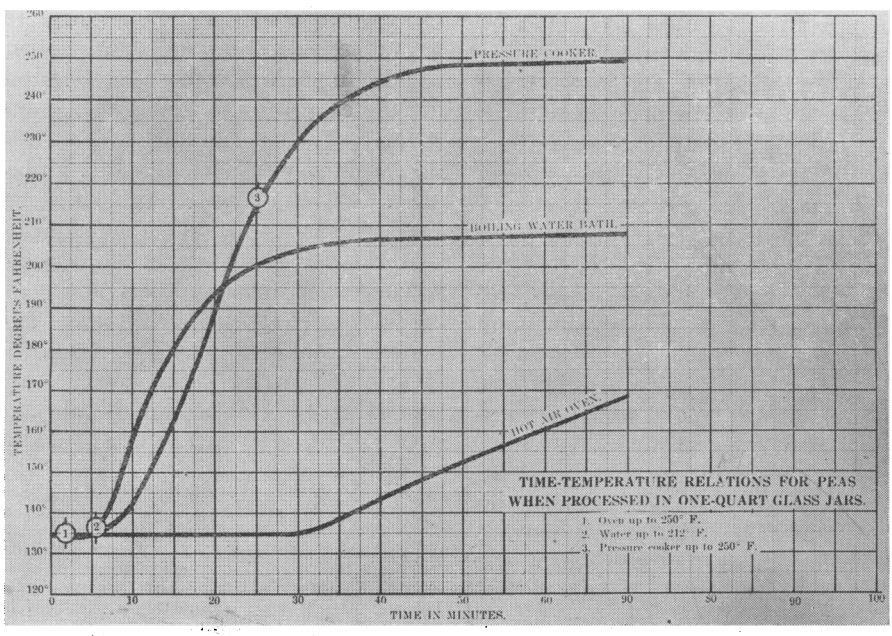
* Recommendations in this bulletin that the home-maker consult the state extension service, in case of doubt, might be questioned. This is good advice only if the extension service happens to be one which has considered all bacteriological knowledge and does not recommend boiling water processes for vegetables. This recommendation has apparently been deleted from recent revisions of this bulletin.

position assumed by the Department of Agriculture. The hot-water-bath process was apparently introduced before much was known about heat penetration. While it may be suitable for acid foods, years of experience with it have shown that it is unsuitable for non-acid foods. It does not sterilize such foods and yields a product in which there is considerable spoilage.

Oven-processing, recommended by manufacturers of some gas ranges and glass jars, is both wasteful and dangerous. Ball Brothers Company recommended this method of processing if the oven is provided with a regulator, since they claim that overheating will cause some " loss of liquid through boiling out of partly sealed jars." They advise starting the time of processing when the required temperature of 275° F. is reached with 3 hours—the maximum heating period for vegetables—even those which have caused many outbreaks of botulism. *The Kerr Home Canning Book* (1933) recommends an oven temperature of 250° F. with a maximum heating time of 240 minutes (4 hours) for any vegetable. They claim that heating temperatures above 250° F. will cause the liquid to boil too hard and evaporate. They also recommend that processing time be counted when the oven is lighted. Such a process might result in undercooked foods. The danger of boiling is probably not serious since the " coming-up time " of the temperature of the jar is so long that 212° F. might not be reached within the recommended time, with some products at least. Furthermore, unsealed foods cannot be heated above 212° F. irrespective of the oven temperature.

Processing of non-acid foods in the oven will not result in a sterile product or in a product which will keep when stored at higher temperatures. It is probably the poorest method that can be advised for cooking canned foods. At the Indiana Agricultural Experiment Station it was found that if the initial temperature of water in a jar processed in the oven was 68° F. and the oven was

FIGURE II



preheated to 275° F., from 95 to 110 minutes were required for the contents of the jar to reach 212° F. as compared with 20 to 25 minutes in a boiling water-bath. With an initial temperature of 158° F. in the contents of the jar, the corresponding times required in the oven and water-bath were from 50 to 55 and from 15 to 18 minutes respectively. These data were secured with water. In foods solidly packed such as spinach, meat, and sweet potatoes, heat penetration would be so much slower that the temperatures at the center of the jar would not reach 100° C. in any processing time which has been suggested by those who use this method.

The success of any method of processing canned foods is determined largely by the rapidity of heat penetration into the container and the thermal destruction time of spoilage microorganisms at the pressure and temperature. This is easily understood when thermal resistance of *Cl. botulinum* at 212° and 240° F. is compared. The resistance of this organism at 212° F. is 360 minutes while at 240° it is only 10 minutes in neutral phosphate solution. Unless sufficient heat penetrates to the center of the jar to destroy microörganisms the product may spoil. Much sound information is available from careful studies long since reported by Ball,* [9, 10] Magoon and Culpepper,[11, 12] and Bigelow, Bohart, Richardson and Ball.[13] These publications cover the subject quite completely and present sufficient data for those advising home-canners, if they will only use them. They need not be reviewed in full, for they are available to anyone interested. Magoon and Culpepper studied the glass jar with various foods.

In order to show the relative rate of penetration of heat into glass jars processed in the steam-pressure cooker, in boiling water at 212° F., and in the oven, the curves shown in Figure II were prepared. They were secured by packing peas in regular quart jars and inserting a thermocouple through the cover to the center of the jar. The jars were then placed in the respective heating units; a preheated standard pressure cooker, a kettle of boiling water, and a gas heated oven preheated to 250° F., for processing. The thermocouples were connected through lead wires to electrical equipment where temperatures at the center of each jar were determined and recorded at frequent intervals during the process. The heating units were operated in accordance with instructions for home-canning except that the pressure cooker was operated at 15 lb. pressure rather than at 10 or 10–15 lb., as suggested in some home-canning books. The oven was preheated in this test although some home-canning books suggest counting time from the time that the cold oven is lighted. The oven was also controlled at 250° F. instead of 275° F., as some home-canning books suggest. Figure II therefore shows the comparable rate of heating of peas in the pressure cooker and in the hot air oven, both operated at the same temperature.

The temperature in the jar located in the hot air oven should not rise perceptably above 212° F., as the container is only loosely closed, and loss of the product will occur if heated above 212° F. The curves indicate that jars placed in an oven really heat more slowly, and do not obtain a temperature during the process above that reached in the boiling water-bath.

The pressure processes suggested for products such as peas should produce adequate sterilization, however, the boiling water processes of 180 minutes or oven processes of 180 to 240 minutes suggested by some of the prominent home-canning books will obtain only from 10 per cent to 16 per cent of the

* Not connected with a firm with a similar name.

sterilizing value of suitable pressure processes.

As the relation of inadequate processing to botulism and the relatively greater difficulty of processing non-acid foods was established, acidification of non-acid foods with lemon juice or vinegar was suggested. Having established that a hydrogen ion concentration of 4.5 had protective action by inhibiting development of *Cl. botulinum*, it was believed that this could be attained by addition of acid. Non-acid foods are highly buffered; consequently such large amounts of acid would have to be added that flavor would be affected. Sunderlin, Nelson, and Levine,[14] for instance, found that acidification of asparagus and sweet corn with phosphoric or citric acid made a 2 hour process satisfactory, whereas without acid even a process time of twice as long was not sufficient.

The U. S. Department of Agriculture since 1931 has been disseminating through *Farmers' Bulletin 1471* (Stanley)[7] satisfactory instructions to the home-canner and the department on frequent occasions has emphatically stated that non-acid foods should be processed only in the steam-pressure cooker. Despite this fact, some concerns making canning supplies to be used in the home, and many agricultural extension services still disseminate unsound, if not dangerous, advice. Dr. A. F. Woods, former Director of Research of the Department placed the department on record as follows:

> There is now no excuse for continuing to take risks involved in canning non-acid foods without adequate pressure cooks.
>
> All recommendations by this department will hereafter make this clear and emphatic.
>
> Government and state bulletins on home-canning have not heretofore specifically disapproved water-bath processes for non-acid products. The attitude now taken by the Federal Department of Agriculture should greatly reduce the danger from understerilization of home canned foods.

The author (Tanner)[6] has already reviewed the situation as far as publications of agricultural extension services and government bureaus are concerned. It was pointed out that only 10 of some 45 states which distribute bulletins on the art of home-canning give methods which take into account sound bacteriological knowledge. These are California, Florida, Maine, Nevada, New York, Illinois, North Dakota, Virginia, Washington, and Texas.* While a few other states have stated that non-acid foods (vegetables and meats) should be processed under pressure, they still give time-tables for hot-water-bath and oven processing. As long as such tables are published, it may be assumed that they are given at least tentative approval and are being recommended to the home-makers of the state.

Another source of information for home-canners are publications distributed by manufacturers of apparatus and supplies for the home-canner, magazine, and newspaper food bureaus. Recommendations of a number of such

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* The author desires to call attention at this time to certain changes which should be made in the former paper. The letter in the table indicating that North Dakota recommends boiling water process for vegetables should be moved to indicate pressure-cooker sterilization. In the context on page 370, this state is mentioned among those with approved recommendations. Virginia should be added to the list in the context making 8 states which distribute sound advice as indicated in the table. The name McCordic (McCordic) should be deleted from the "author" column after Wisconsin. Mrs. McCordic was the author of a Special Circular, November 1932, in which the steam-pressure cooker was recommended for vegetables. Eight months later in July, 1933, *Circular 261, Home Canning and Jelly Making*, was published in which boiling water processes were recommended for vegetables. Both of these publications bear the imprint

"Extension Service of the College of Agriculture
The University of Wisconsin, Madison"

Mrs. McCordic was apparently not the author of the latest publication (*Circular 263*, October, 1933).

Extension Bulletin 183, Extension Service, State College of Washington, June, 1933, apparently supersedes the undated mimeographed material used in the first paper. The steam-pressure cooker is now recommended for non-acid vegetables with processes given in *Farmers' Bulletin 1471*. Information is also at hand that the extension service of Maine now recommends the pressure-cooker for non-acid foods.

authorities are shown in Table II. It will be seen that a few give reliable advice about processing vegetables, recommending only the steam pressure cooker. On the other hand, much unreliable advice is still disseminated even by some of the largest manufacturers of equipment for the home-canner. Some 10 advise oven-processing which is known to be wasteful and dangerous while practically all of them recommend the boiling water-bath. Health officers would be justified in insisting that these authorities avail themselves of all bacteriological knowledge.

Many statements in these publications are both misleading and scientifically unsound. For instance the Kerr Glass Mfg. Corp., in a small booklet, *Modern Method of Home Canning,* by Kerr, states that Louis Pasteur gave us the method of pasteurizing milk and proved that growth of bacteria in foods is the cause of spoilage. It then continues, that Pasteur discovered two fundamentals of successful food preservation—complete sterilization of the product, and perfection of absolute airtight seal. The Kerr principle of sealing is said to insure achievement of these results. Complete sterilization cannot be attained by the process times and temperatures recommended on the later pages of this booklet nor in the much larger *Kerr Home Canning Book.* The type of closure on the jar has very little to do with successful sterilization. It is but one of many necessary requirements for successful canning. It may, however, prevent bacteria from gaining entrance from the outside environment after those in the food have been destroyed by the process. This same book gives as the first step for successful canning: " complete sterilization (entire destruction of all microorganisms such as yeast, bacteria, and mold)." Such a bacteriological utopia has not yet been reached even by factory canners who are using longer cooks.

The recommendation that non-acid foods (vegetables) may be processed in the hot-water-bath and oven, can but lead to a high percentage of spoilage and occasional outbreaks of food poisoning. As long as such processing advice is given in publications, it may be assumed that those who distribute them, recommend them to the home-canner even though they may state that the U. S. Department of Agriculture recommends only the pressure cooker for non-acid vegetables and meats. There is nothing to prevent the home-maker from gaining the impression that a boiling water process is just as satisfactory for non-acid foods as a steam-pressure process. If time-tables are given for such methods of processing, it may be assumed that they are approved. The reader is left to puzzle over the many inconsistent statements.

These statements apply equally well to the *Ball Blue Book of Canning and Preserving Recipes.* It also quotes the recommendations of the U. S. Department of Agriculture to the effect that pressure cookers should be used for vegetables and meats, even though time-tables on hot-water-bath processes for these foods are given. The writer has been informed that canning instructions distributed with the " Presto " jar made by the Owens-Illinois Glass Co., and distributed by the Cupples Co., of St. Louis, are to be made to conform to good canning practice. In their present form they are not acceptable. The statements * made about the publications of several companies in the above paragraphs apply equally well to those of some other manufacturers, as shown in Table II.

* It has been difficult to determine in some publications whether the boiling water process for vegetables is approved. Statements may be made about the danger of such processing and attention called to the position now assumed by the U. S. Department of Agriculture, yet time-tables be published for boiling water. Where a publication included time-tables for such processing, the author has assumed that this method was approved.

That many of those who recommend procedures to home-canners do not have entire confidence in the products is suggested by the oft-repeated advice, "all vegetables and meats canned at home should be boiled 10 to 15 minutes before tasting," or "thoroughly re-heat all canned vegetables and meats before using." The advice is also given that if home-canned vegetables are desired for salad, re-heat and then cool before using.* The statement that the U. S. Department of Agriculture recommends the pressure cooker for non-acid foods appears frequently. These statements indicate that constant fear of food poisoning obtains in the minds of these "authorities." This fear is justified, for every year inadequately processed home-canned vegetables take their toll of human life.

The publications just mentioned are widely distributed in the United States even in those states where home economics and extension services are endeavoring to disseminate only reliable information. While state authorities are insisting on proper methods of processing, the bulletins and circulars distributed by canning supplies manufacturers may do much to interfere with this program. Despite the fact that many of these bulletins quote the position of the U. S. Department of Agriculture on pressure cooks for non-acid foods, they persist in giving the time-tables for oven and water-bath processing of these products.

Some newspaper food bureaus and magazines also disseminate unsound advice. *Capper's Farmer* for February, 1934, had an article on "Tips on Canning Meat," in which the pressure cooker and boiling water processes are recommended—the latter to be carried out in a wash-tub. Home-makers who follow such advice are bound to have grossly under-sterilized products.

Canning contests are frequently used by some manufacturers and others to stimulate interest in home-canned foods. Foods packed for such exhibitions are judged mainly by color and appearance and not on the basis of sterility. In fact, one home canning instruction book states: "Temperatures higher than boiling tend to injure the delicate color and texture of most fruits."* The implication is then, that color and texture are paramount. Boiling water processes are generally considered to be safe for fruits if the time is sufficiently long.

A part of the unfortunate situation discussed in this paper may be laid at the doors of many departments and schools of home economics. They continue to give in courses and publications advice which is unsound. Many of their graduates are employed by commercial concerns and bureaus disseminating misinformation, and thus the situation is made more serious. Not much improvement can be expected until misinformation is stopped at its source. Those who speak with authority from any position are duty bound to give none but the safest and soundest advice. Fortunately, the situation is beginning to improve. It is significant that the radio is playing an important rôle. The author has heard two talks on home-canning in which the boiling water process was recommended for vegetables. On the other hand, he was told of another in which most trustworthy statements were made.

SUMMARY

The procedures recommended to home-makers of America by some agricultural extension services, newspaper

* This is good advice and is necessary as long as some present methods are used. It is more logical to destroy the organism itself than to attempt to destroy the toxin after it has been formed. The home-maker should make certain that the food has actually boiled for some time. Owing to numerous outbreaks of botulism at high altitudes 10 minutes' boiling may not be sufficient under these conditions

* Such characteristics should be of secondary importance to keeping quality and health hazards.

bureaus, and manufacturers of supplies for home-canners are reviewed and appraised in light of bacteriological knowledge which has been accumulated during the last 15 years. Since there have been no outbreaks of botulism caused by factory-canned foods in America since 1925, and since home-canned foods cause numerous outbreaks each year, it is suggested that this unfortunate situation may be largely due to inadequate recommendations by some of the authorities mentioned above. Arguments are developed to show that those who disseminate advice to home-canners should realize their responsibility to the public in such matters. Non-acid vegetables and meats should be processed only under steam pressure and not in the oven or boiling-water-bath. Until preservation of perishable food products by heating in wash-tubs, wash-boilers, lard cans, and other such containers is entirely eliminated, outbreaks of food poisoning will continue. Although the U. S. Department of Agriculture has placed itself on record very emphatically as opposed to the use of such methods, and distributes a reliable publication to home canners in *Farmers' Bulletin 1471,* only 10 extension services connected to state agricultural experiment stations have seen fit to adopt similar recommendations; these are California, Florida, Maine, Nevada, New York, Illinois, North Dakota, Virginia, Washington, and Texas.

Attention is also directed to the statements made in many publications of manufacturers of canning supplies for the home-maker. Many of them are not only unsound bacteriologically, but may mislead a home-maker into situations where she may not only subject her family to serious health hazards but pack a product which will show high incidence of spoilage when stored under average conditions in the home. Health officers and other may play a rôle in directing attention to sound practice for preservation of foods by canning in the home.

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